THE

OCTOBER 1949

MGA BULLETIN

No. 17

ORGAN OF THE MUSHROOM GROWERS' ASSOCIATION

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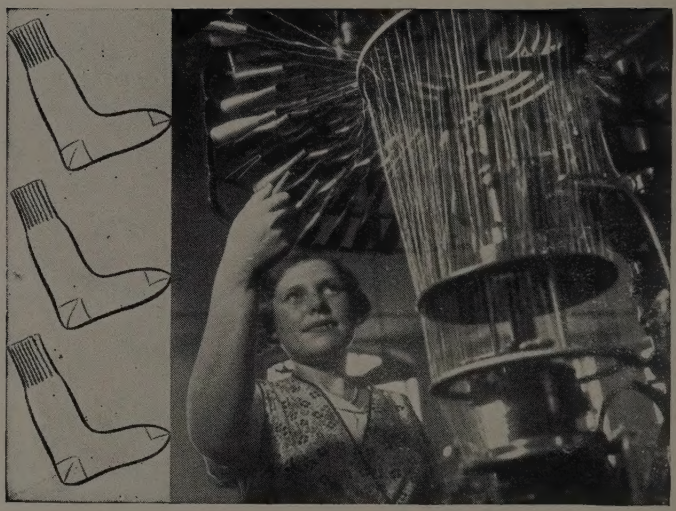

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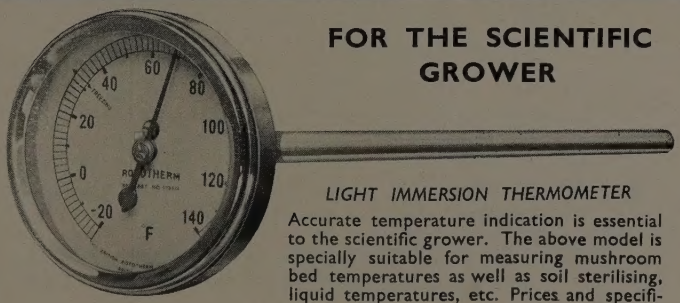

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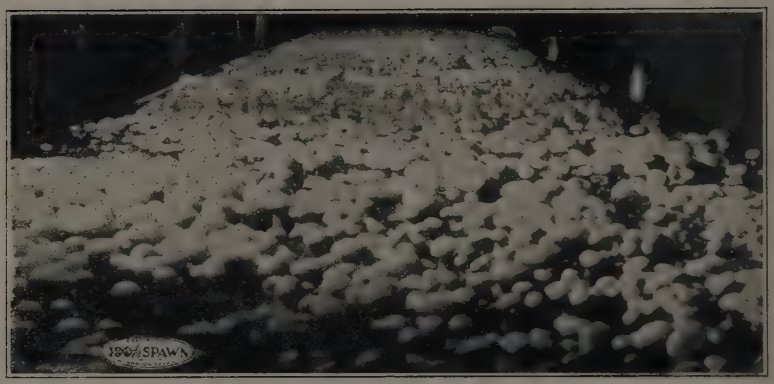

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THE

OCTOBER 1949

BULLETIN No. 17

No responsibility can be accepted by the Editor, the Editorial Board, or the Mushroom Growers' Association, for statements made or views expressed in this Bulletin, or for any advertisements included in this publication.

EDITORIAL

The two main trends of mushroom growing in this country are : a conversion to the Tray System (or Two-Zone System), and a lively interest in the new ' short ' method of composting.

The first was discussed by Dr. Sinden in his article in Bulletin 9 and many growers were quick to seize upon the advantages which this system offered. In September last year they had the opportunity of talking the matter over with Dr. Sinden himself whilst he was over here as the guest of the M.G.A. Since then evidence has come to hand that more and more growers are showing interest, although they were warned by Dr. Sinden that there were snags for the unwary. He said that to be a success full mechanisation must be employed, and we have many reports which bear this fact out. Without mechanisation the handling costs are prohibitive—in fact the whole idea merely adds to the expense without increasing the efficiency of growing.

The ' short ' method of composting, on which Dr. Sinden is preparing a paper, does not guarantee more pounds to the square foot but it does give more pounds to the ton of manure. It is important to use our raw materials to their best advantage : during the late war the inefficient mushroom grower in Switzerland was not allowed supplies of manure, and the cost alone is likely to make this point of healthy interest to our growers. On the principle of pounds to the ton rather than pounds to the square foot, the Americans have increased their yields from 140 to 250 and 300 lbs. per ton of fresh manure, and under experimental conditions as much as 600 lbs. has been obtained. Dr. Sinden, who is the founder of the ' short ' method, does not want his paper anticipated but has promised us full details as soon as possible. As with the Tray System there are snags and the principle must be fully understood to obtain success. He states : " We compost manure outside in 10 to 12 days by obviating the central anaerobic core, but it is not so simple to change over to this method, as it requires a very different technique. You have to start all over again and forget what compost should look like. But it does grow mushrooms; I have had as much as $1\frac{1}{4}$ lbs. in one break."

FROM THE SECRETARY

NEWS FROM M.G.A. HEADQUARTERS

The informal ' Open Day ' held at Yaxley on the first Thursday in each month is proving to be a success. Members are taking advantage not only of visiting Headquarters, the Research Station and Messrs. Noble Mushrooms Ltd., but of talking things over among themselves. Besides members, our recent visitors have included growers and scientists from France, Norway and Finland.

During the past quarter I have had the opportunity of visiting members' farms in Northamptonshire, Shropshire, Buckinghamshire, Leicestershire and Yorkshire, and I hope to be able to continue the practice. From what I have seen and heard it is obvious that the hot weather experienced during July and August has been the source of much trouble. What do you do with a good spawn run, a proven soil —and a bed which produces masses of dying pin-heads ?

There are indications that the Government would like to abolish trade barriers and tariffs in the general spirit of Western Union, assuming that it is only economic for each country concerned to produce that commodity for which it is best suited. This sounds good on paper, unless you happen to be in one of those ' lines ' which another country does in a big way. In the event of a quarrel/war I assume we start resurrecting the industry which went down the drain—Agriculture, 1939, and all that. Unfortunately, history and common-sense have always been poor arguments.

During the course of the next twelve months four modern works on mushroom growing will be published and there is room for them. So much literature published for our industry is either puerile (' just nothing to it . . . . following the directions on the packet ') or learned ' papers ' which leave the grower with an admiration for learning and a dislike for Latin. Both Dr. Sinden and Dr. Kligman of the U.S.A. are preparing books, I understand, and our own Fred. C. Atkins has just completed his manuscript. Added to these, Mr. Glasscock's revision of Bulletin 34 : *Mushroom Growing*, is in the hands of H.M. Stationery Office.

Research Open Day —1950 : Suggestions will be welcomed from members on the subject of improvements for the M.R.A. Open Day, tentatively fixed for Thursday, 4th May, 1950. One proposal which it is hoped to adopt is that a large marquee be used for the lunch on the spot—and any short speeches necessary. Another is that we have a trade exhibition tent, to give sundriesmen and manufacturers the chance to meet members and to demonstrate machinery used in the industry. The invitation to visit Messrs. Noble Mushrooms Ltd. has again been extended to all members and their guests.

MUTUAL AID

QUESTIONS & ANSWERS COLLECTED BY THE SECRETARY

Q. 131. *Do you advocate that horse manure should be reinforced with trace elements and growth substances to put a greater store of food into the compost? What are the best commercial sources of 'growth substances'? Would waste from brewer's yeast be a suitable source of Vitamin B for instance? Or is it simply good management of horse manure alone which is responsible for excellent crops?*

We do not know yet what kinds of horse manure need to be reinfored, but we do know that the M.R.A. activator can be used with straw to dilute horse manure successfully, and if you think your supply lacks droppings this would be worth doing. You would have to estimate what proportion of surplus straw the manure contains, allow for the fact that it is wet, and add the corresponding amount of activator. We do not know enough about the use of growth substances to give definite advice. We are experimenting mainly with beef extract. Brewer's yeast is a good source of Vitamin B, but we have not tried it on mushrooms.

Q. 132. *I notice on page 91 of Bulletin 15 that Noble Mushrooms Ltd., of Yaxley, obtained 7½ lbs. per square foot. This must surely be a world's record?*

Noble Mushrooms say they have never grown 7½ lbs. per square foot from any one crop. What they did last year was to produce 7½ lbs. per house—but their crop cycle is 20 weeks, so that this figure should be divided by 2½ to give the average yield per square foot per crop.

Q. 133. *I have been growing in disused brick kilns, but want to erect prefabricated houses. I thought of the plaster-board type well lined inside with tarred paper to prevent any fungus spores from getting well bedded in the walls, but these houses suffer from the effect of damp very badly. Are Nissen huts any good? As the new site is on rising ground I could bury the huts in the earth but everything would have to go in and out of the same door: I am going to use trays so this might not be a serious drawback.*

The trend of growing houses to-day is towards small units, prefabricated if possible, and the Handcraft Hut is used quite a lot. It does stand up to conditions better than the Nissen hut, but the latter is cheaper and can be well insulated with glass wool or aluminium foil. I think one doorway would be a mistake, but the rising ground can be used to advantage for filling as you will be able to fill your top beds from the 'high' end of the house The Americans found this a great advantage in their six and eight tier houses.

Q. 134. *We are getting masses of pinheads but few mushrooms—about ·5 lbs. per square foot, and this coupled with to-day's prices does not exactly show a profit! Our houses (1,200 square feet) were filled with 12 tons racehorse long and 4 tons short manure, plus 4 cwt. gypsum in one case, and 12 tons long manure, 3 cwt. gypsum, plus 1 cwt. Adco 'M' in the other. The compost was turned four times and made a good heating, ranging from 130—160° F. When the houses were filled we peak-heated with live steam getting 128° F. and 138° F. The steam was on for seven hours. We spawned one quart to 35 square feet and the casing soil was a sandy loam. The soil in one house had a pH of 4·8 to which we added 26 lbs. of hydrated lime per ton, the other being 6·6 (pH) we added 10 lbs. of lime per ton. The temperature during the hot weather was high, up to 76° F. and humidity was kept as high as possible by watering the floors, etc. By the end of the fourth week in each house strong, or rather thick mycelium, threads began to cover the surface of the bed and after another week pinheads by the thousand began to appear. They then turned brown and 'faded away.' The few mushrooms which did appear did the same trick. The casing soil by the way was second spit and not sterilized. We are in a warm valley and the temperature has not been lower than 60° F. for the last two months and well over 70° F. on more than one occasion, owing to poor insulation. Is there some hope for me yet?*

I can see nothing radically wrong with your methods and assuming that you had a reasonable compost, got a peak-heat, and are using a soil which does grow mushrooms, there is only one answer—the unusually high temperatures prevailing coupled with poor insulation. Other growers are complaining of the same thing and it happens each year. The three months starting half-way through May are a headache to most growers and until we get perfect insulation will always be so. I will be interested to hear the opinion of other growers on this case.

Q. 135. *We have a very heavy infestation of wood lice in the compost heap under preparation, due we believe to a stack of boxes which are nearby. We have been unable to creosote them due to the late delivery, but have dipped them in a solution of formaldehyde. Will this exterminate them ?*

It is doubtful whether formalin will destroy the infestation of wood lice : it would be better to use Gammexane. Get a peak heat and dust with Gammexane, or if you cannot peak heat use the Gammexane alone.

Q. 136. *My manure will arrive about 19th August. Would you advise going over the house with a flame gun and carrying out necessary fumigation with formalin now or leaving this until a period just before the house is wanted ?*

The use of a flame gun is not essential : as soon as the house is empty spray with cresylic acid, keep it closed, and just before filling fumigate with formalin.

Q. 137. *I am thinking of using the Handcraft Hut, but it seems to lack many of the necessities of the perfect mushroom house. Can you give me some facts ?*

The Handcraft Hut gives just under 1,000 square feet of bed arranged in two sets of three tiers, and providing you raise the whole hut on a brick surround (about 18") your top beds will be same size as the others, you will have room to ' work ' them and better ventilation. Five standard ventilators will be sufficient, although vents at each end of the house will give better control.

Q. 138. *I am thinking of selling mushrooms to individuals, hotels, shops, etc. What would be a good price for the whole year ?*

The best average price this year which has come to our notice is 4/8 and the trend is downwards. An all-year-round price of 4/- would be quite good.

Q. 139. *I wish to try Gammexane dust but find that I can only obtain it in 1 cwt. bags ; is it possible to obtain smaller quantities ? My houses are 5,000 cubic feet and the Gammexane smoke generators are for 8,000 and 12,000 cubic feet. Will the stronger concentration cause tainting ?*

Quite a number of growers use stronger concentrations of Gammexane than necessary and I have heard no reports of tainting, although some complain that the smell of the Gammexane in the house destroys their sense of ' smell ' as regards trouble ! Messrs. Plant Protection put on the market a Gammexane preparation known as ' Abol Wireworm Dust ' in 2 lb. and 7 lb. tins at 4/- and 10/- per tin and they recommend using this at the rate of ½ lb. per 1,000 square feet of bed, applied at 10—14 days intervals. It is specially prepared to prevent tainting.

Q. 140. *If three tons of good wheat straw (making 1,000 square feet) takes a given quantity of Activators A, B and C, what percentage of the same activators should be put with very strawy racing stable manure (ten tons) which makes 1,000 square feet ?*

You will appreciate that it is impossible to suggest a quantity without knowing what each delivery of manure is like, and it is not easy to judge after seeing it. The most useful way of tackling the problem is to estimate by inspection, the proportion of good manure and of plain straw respectively which would make up the manure delivered. For example you might consider in a ten ton delivery you have three tons of good heavy stable manure, and seven tons of straw. You must allow for the fact that the manure is partly wet, though not as wet as required, and the quantities of activator given in the M.R.A. formula are based on the weight of dry straw. After allowing for moisture add enough activator for the estimated weight of dry straw. It is still important to wet this light manure thoroughly before stacking with the activator, and that is not as easy as with baled straw (using the Noble Drip Method). You might stack the light manure and wet by means of a drip pipe lined along the centre of the pile for a day or two (until it runs out of the pile) before adding the activator.

Q. 141. *I am investigating the possibility of pasteurising my casing soil in preference to sterilizing by steam. Can you give me any information on the subject ? I have a room 10′ by 10′ which I might easily insulate—and I have in mind placing the soil in wire trays about 3″ to 4″ deep and then injecting steam into the room at very low pressure from a small boiler—say 10 lbs. per square inch. I do not think a great deal of steam would be required to bring the temperature up to 160° F. Do you know of any member who has tried this ? I even wonder if a pan of water with a gravity feed in which an electric immersion heater was placed would give off sufficient steam to get the necessary temperature, which I proposed to maintain for four hours.*

We have no knowledge on this subject. Can any member help ?

How to Pack Specimens

by

Miss C. DUNCAN, M.R.A. Microbiologist

Badly-packed half-decayed specimens sent by post do not give a clear picture of trouble as the grower sees it in his mushroom beds. Symptoms which may be obvious to him at the time of packing can be obscured quickly and easily by soil and dust, and moulds which attack dying material. Making certain that the specimens arrive in the best possible condition affords a better chance of having the problem solved. Important, too, is the letter accompanying the specimens. State exactly what has been noticed and as many details as appear relevant, e.g.—

Date when specimen was taken ;

Particulars of previous occurrence (if any) and duration ;

Exact location ;

Environmental conditions (temperature, humidity, ventilation) ;

Treatment applied to date (if any).

If mushrooms are sent they should be pulled in the normal way, and after shaking away as much loose earth as possible, each should be wrapped separately in waxed paper or cellophane and packed firmly with paper between them in a wooden or tin box.

These directions also apply to spawn which is suspected to be mouldy or dead, and large fungus weeds or invaders.

For identification of invading fungi in soil or compost, samples may be sent packed in flat tobacco tins or in jam jars with a cap of tin or card or several layers of fresh greaseproof paper secured by adhesive tape.

Details concerning soil should include source and treatment of the soil up to casing of the beds. When compost is sent, the type of manure used (e.g., heavy or racing stable manure), the number of turns given to the compost and whether peak heating is practised, should be stated.

Mites and insect pests should be collected and placed in small glass bottles or tubes. Mushrooms or spawn thought to be damaged by these pests should be sent at the same time and packed as suggested.

All these details may appear to be exacting, but they mean all the difference between prompt attention and a long list of queries accompanied by a request for fresh material.

Fred. C. Atkins Thinking Aloud . . . . . .

More about Eelworms

Several growers who found their spawn dying at the very moment they read my note in the last Bulletin wondered whether nematodes (eelworms) were to blame, but the composts I investigated personally either turned out to be too wet and under composted or were infested with springtails and mites. These creatures can certainly do immense damage, but they can usually be controlled at any stage in the life of the bed; eelworms are rarely discovered until it is far too late to kill them by pasteurization.

Three months ago I promised a note of real interest in this connection —I was thinking of some advance information I had received from the United States. Now that Lambert, Steiner and Dreschler have published a note in the *U.S. Plant Disease Reporter* on the subject I am at liberty to discuss their important observations. Several growers in this country during the past two or three years have noticed a sparse growth of mould on the surface of their casing soil, and, finding no mushrooms in those areas, have dug down into the bed and found the compost rank and the spawn non-existent.

At various times this mould has been called *Tricothecium* and *Cephalothecium*, but it has now been identified as an *Arthrobotrys*. Compost from below the mould found in nine separate mushroom farms in Pennsylvania and in two in Delaware was examined, and in every instance an undescribed species of *Ditylenchus* (an eelworm) was observed feeding on the mushroom mycelium.

Several years ago at Yaxley we had two patches of this mould. Samples were taken by La Touche, who pointed out to me at the time that the compost was infested with eelworms. He told me that the mould was actually capturing the eelworms, but the M.R.A. programme was synthetic compost, and no work could be done on this new problem.

Happily the Americans have been able to look into it more closely, and they now state:

"All the evidence suggests that the symptoms associated with '*Cephalothecium*' disease may be explained on the basis of the invasion of the beds by nematodes in sufficient numbers to consume the mushroom mycelium, followed by the development of predaceous fungi which prey upon the nemas and sporulate on the surface of the soil."

Lambert and his colleagues go on to observe that in some cases according to mushroom growers who have suffered from their depredations, the eelworms remain in the house between crops, presumably in the bedboards. In other cases they probably came in with the compost or soil. If in fact they are killed in half-an-hour at 125° F. I am inclined at the moment to blame the casing soil.

The eelworm in question is the first species that appears to feed entirely on fungi. They go on to say "it punctures the mushroom mycelium and feeds on the contents of the hyphae, destroying them directly or indirectly . . . . . .(It) appears capable of rapid growth and propagation, eventually building up enormous numbers which migrate

and spread through a mushroom bed and effect the destruction of the mycelium on an advancing front."

And a final word to cheer us up : " Methods of control are also being studied." Please keep us in touch, Dr. Lambert !

Trying to Baffle the Scientists ?

"GROWER" photograph

Cheshunt is investigating the growth of mushrooms in steam-sterilized soil, said Dr. W. F. Bewley, Director of Research, at the Annual Meeting of the Nursery and Market Garden Industries' Development Society Ltd. Among the visitors to Cheshunt's Open Day were (left to right) : Dr. R. L. Edwards, Director of Research, Mushroom Research Association ; Mr. C. Lockie, of Plant Protection, Ltd. ; and Mr. Angus Watson, Secretary, Mushroom Growers' and Mushroom Research Associations.

ITEMS OF GENERAL INTEREST

Additions to M.G.A. Library : " Insect Pests " (*N.S.W. Agricultural Gazette*, March, 1949) and G. J. Shanahan's " B.H.C. and Mushroom Pests " (*N.S.W. Agricultural Gazette*, April, 1949), presented by the New South Wales (Australia) Department of Agriculture. National Farmers' Union Year Books (1948 and 1949), presented by the N.F.U. Darlington's *Mushroom News*, Vol. II, Nos. 2 and 3 (1949), presented by W. Darlington & Sons Ltd., *Champignonanbau*, by W. Hunte (in German).

Dr. Toivo Rautavaara : This distinguished Honorary Member of the M.G.A. and author of the stupendous " Studies on the Mushroom Crop in Finland," now in the Library, visited Yaxley in August to discuss modern methods of mushroom growing.

Show Successes : Congratulations to the irrepressible **Mr. George Rice,** who carried off premier honours for white mushrooms at both Southampton Show and the Sussex County Show at Hassocks this year ; to **Mr. P. Danks,** who was first in one mushroom class and third in the other at Southampton ; to Messrs. **A. G. Sparkes,** who showed the best brown mushrooms at Hassocks and were runners-up to Mr. Rice at Southampton ; and to **Lindfield Mushrooms**, who were runners-up to Mr. Danks at Southampton. All are members of the M.G.A.

Cultivated Mushrooms

PRINCIPLES OF GRADING AND PACKING

Proposals of the M.G.A. Grading and Packing Sub-Committee.

GRADES

(1) **BUTTONS :** Membrane securely intact—that is, likely to remain unbroken for 24 hours.

(2) **CUPS :** Membrane breaking or broken –that is, the mushroom in an open stage of maturity, the cap retaining a pronounced downward curve.

(3) **FLATS :** Those advanced beyond the cup stage, the cap forming a letter " T " with the stalk.

In all three grades the cap diameter to be 1"—2½" (with ¼" tolerance) and stem length not to exceed 1", ¾" stem limit in the case of the Button grade.

Other Grades such as small buttons (under 1"), large Flats (over 2½") and others, may be used to suit local requirements.

Ungraded mushrooms not complying with the above to be relegated to a pack labelled " Ungraded."

Stems. To be packed separately and labelled " Stems."

PACKS

1. Varieties to be packed separately according to colour.

2. All graded mushrooms to be free from :—dirt, disease, insect damage, malformation, pronounced discolouration or other serious blemish.

3. Each grade to be in a separate pack.

4. Mushrooms to be laid in the container stem upwards in orderly layers to within one inch of the top of the container at the time of packing.

5. Coloured (blue) paper lining is recommended to enhance the appearance of the pack, but its use is optional and should be avoided in the summer months. White paper should be avoided except for brown mushrooms.

6. Size of containers optional to allow preference being given to the particular markets served.

7. Nett weight not to exceed 4 lbs. in any one container, and contents measured to the lower ½ lb., no other fraction being permitted.

8. Type of container to be the wooden chip when obtainable, otherwise the cardboard container may be used.

9. Covers to be of wood or cardboard, and to be securely fastened. A paper cover (over-cover) may be added, but not cellophane or material of similar type.

10. The cover, or over-cover, to be marked **indelibly** with :—Type (colour) of mushrooms, grade and nett weight.

Dr. R. L. EDWARDS reports to the Mushroom Industry :

Developing a Synthetic Compost

1. CHOICE OF THE SOURCE OF NITROGEN

The Editorial Board has asked Dr. Ronald Edwards, Director of Research at the Mushroom Research Station, Yaxley, to write a series of articles for the M.G.A. Bulletin, explaining in grower language the stages by which the present M.R.A. formula for synthetic mushroom compost was evolved. The first of these articles is given below.

Straw has been composted with many different nitrogenous materials ranging from the cheap and simple ammonium sulphate to complex organic by-products. When we reviewed previous work on mushroom composts three things were quite clear :

1. The form in which nitrogen was to be supplied was very important.
2. Published statements on the best form to use were conflicting.
3. Many of the materials used, particularly in America, were not available here.

Dried blood had given the best results in American experiments ; it is also one of the most expensive materials tested. Three experiments have now been carried out, and another is in progress, in the search for a better source of nitrogen of one which is equal to dried blood, but cheaper. It is not worth sacrificing yield for a cheaper compost because the additional cost of the dried blood in the present formula (M.G.A. Bulletin No. 15) is well covered by 2 ozs. of mushrooms per sq. ft. The drop in yield when any other source was used was greater than that.

Nitrogen Experiment No. 1.

Twelve stacks of compost were made, six with 250 lbs. of dried blood per ton of straw, and six with 75 lbs. of ammonium sulphate and 110 lbs. of nitrochalk. This mixture is claimed to equal urea which is often recommended for mushroom composts. These groups were further sub-divided and other treatments were applied equally to both groups. The results of such a factorial experiment can be analysed to determine the effect of the nitrogen sources separately from any other treatments, and a factorial experiment allows more information to be gained from a given number of beds than any other design. This type of experiment is therefore widely used for nutritional studies in agriculture.

The main results are shown in the following table :—

	Mushrooms per sq. ft.	lbs. per sq. ft.
Dried Blood	18	0·88
Inorganic mixture .	10	0·56

Nitrogen Experiment No. 2.

In the next experiment plain nitrochalk was compared with dried blood. This also was a factorial experiment and the six stacks of compost on each source of nitrogen were further divided to include three different

proportions of potassium. Ground limestone was added with the dried blood to balance the calcium supplied in the nitro-chalk. The dried blood composts seemed rather greasy at the last turn and they were given 7 lbs. of gypsum extra per ton (original wet weight) of compost. All other constituents were the same in the twelve stacks. The quantity of superphosphate was raised in this experiment, in the light of a later result probably too high, and the weather was extremely cold, making temperature control difficult. Probably these two factors account for the slow crop and poor yield obtained. However the experiment did not depend on comparison with any others, and analysis showed that the results obtained were statistically significant.

In this experiment the temperature at a fixed point in the hot part of each stack was taken daily. For comparison the maximum values obtained between turns are averaged in Table 1, which also gives the intervals from spawning to picking.

The yields cannot be as simply stated because the effect of potassium depended on the source of nitrogen and results for the six different combinations are given separately in Table 2.

TABLE 1

	Stack temperature	Interval spawning-picking
Dried blood	144° F.	97 days
Nitrochalk	139	130
Potassium sulphate 14	149	110
(lbs. per ton of straw) 63	147	110
112	145	120

TABLE 2

Source of N.	Potassium	Mushrooms per sq. ft.	lbs. per sq. ft.
Dried blood	Low	18	0·80
	Medium	13	0·55
	High	6	0·29
Nitrochalk	Low	1	0·04
	Medium	4	0·20
	High	7	0·33

There was an over-all difference in favour of dried blood and also the effect of additional potassium was reversed by changing the source of nitrogen. This was a surprising result ; in view of the great superiority of dried blood the effect of potassium in composts made with nitrochalk is of less practical importance and has not yet been followed up.

Nitrogen Experiment 3.

The two experiments already described had shown that dried blood makes much better compost than the inorganic materials tested. The question then arose whether a smaller proportion of dried blood would give equally good results if the same total nitrogen was made up with other materials. An experiment was arranged in which two mixtures of dried blood and nitrochalk in proportions 1 : 3 and 3 : 1 were used, to supply the same total nitrogen to the compost. This also was a

factorial experiment, the six stacks made with each nitrogen mixture being divided into three groups, one having no further supplement, one sugar beet tailings and one castor bean meal. These materials were tested because they might perform useful functions which however are outside the scope of this report. There were twelve stacks, two for each of the six possible treatments.

After filling and spawning a further experimental treatment was introduced. We had noticed that synthetic composts in our houses become very dry on the surface. In an attempt to prevent this the beds on one side of the house were very lightly misted over twice weekly from spawning to casing. Only enough water was applied to moisten the surface of the compost. There was never enough water to run down into the beds.

This treatment stopped when the beds were cased two weeks after spawning.

The average maximum temperatures during composting were :—

75% dried blood 138° F.
75% nitrochalk 131° F.

The sugar beet tailings had a marked stimulating effect in the 75% nitrochalk composts, but little effect on the others, and the results of all the six treatments must be shown separately to give a fair statement of the results after 12 weeks picking, in Table 3.

TABLE 3

	Spawning-picking days	Mushrooms per sq. ft.	Lbs. per sq. ft.	Av. size ozs. per mushroom
75% Nitrochalk				
No supplement	99	5	0·64	1·9
Beet tailings	71	17	1·21	1·1
Castor bean meal	96	8	0·93	1·7
75% Dried blood				
No supplement	80	16	1·18	1·2
Beet tailings	77	17	1·22	1·2
Castor bean meal	80	21	1·42	1·1

There is no doubt about the superiority of the high-blood composts without supplement and with castor bean meal. Sugar beet tailings raised the yield from the low-blood composts to equal that obtained with more blood, a most interesting result which is being followed up in a further experiment. Until it has been thoroughly confirmed it would be unwise to consider it applicable in commercial practice.

The effect of castor bean meal was straightforward but smaller, and really needs confirmation.

It is interesting to note that where the beet tailings stimulated a great increase in the number of mushrooms produced, without contributing any substantial amount of nutrient material to the compost, there is a compensating decrease in size of the mushrooms. This effect has also been observed in other experiments where purely physical causes have altered the number and size of mushrooms in opposite directions.

The best single bed in this experiment gave 2·4 lbs. per sq. ft., and the best average from a complete group of three beds was 2·1 lbs. per sq. ft.

SUMMARY :

Dried blood is a better source of nitrogen for mushroom composts based on straw than nitrochalk or a mixture of nitrochalk and ammonium sulphate. 75% of dried blood is better than 25% in mixtures, with nitrochalk supplying 25 and 75% respectively of the total added nitrogen.

RESEARCH APPEAL FUND

The Executive Committee may have been ambitious in fixing the target of the Research Appeal at £2,500, but the Fund now stands at £2,330.

If those who have not yet sent along to Yaxley contributions towards the maintenance of the important research work in progress would ponder the consequences of its having to be curtailed or even abandoned, the remaining £170 would materialise overnight.

The following cheques received since Bulletin 16 was published are gratefully acknowledged :

	£	s.	d.		£	s.	d.
C. L. Sinfield	20	0	0	Dr. E. Hauser (Switzerland)	5	0	0
Major W. L. Haycock	10	0	0	J. B. Knaggs	2	2	0
B. Pratten	5	5	0	Dr. N. Rawstron	1	1	0
J. Wood & Sons	5	5	0				

Fred. C. Atkins on : Competition from .....

Papulaspora byssina Hotson

Alternative Names : Brown Plaster Mould, Brown Plaster.

Characteristics : White patches appear on exposed surfaces of compost or casing soil, and a few days later turn cinnamon-brown with the formation of powdery granules (known as " bulbils ").

Original Source of Infection : The mould lives in soil, and is probably introduced with the manure.

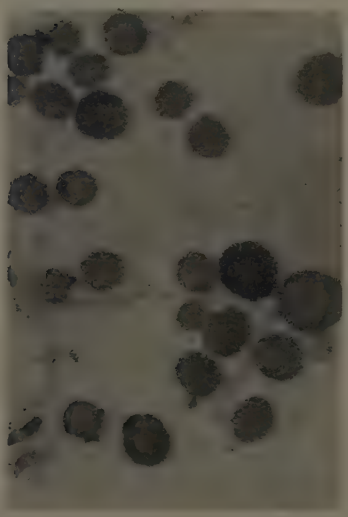
Prevention : Brown Plaster Mould rarely appears on fully-composted manure containing less than 66% water. It probably survives a pasteurizing temperature of 130° F. Always sterilize composting site before making new stack.

Control : Spray with 2% formalin or allow to turn brown before casing. Exercise great care in not carrying " bulbils " to new beds.

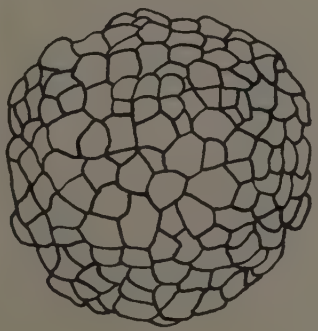
Technical description : Mycelium white, procumbent, scanty on most media ; bulbils light straw or cream-coloured, becoming brownish with age, more or less spherical in form, 100-250μ, occasionally elongated to 350μ in diameter, produced in fluffy aerial clusters, primordium one or more short lateral branches twining spirally about the main branch. No other means of production at present known. —After Hotson.

Hyphae composing the mycelium are septate, hyaline, and 2-5μ in diameter (commonly 4μ). —After Ware.

Invaded ridge beds showing Brown Plaster Mould on the surface of the casing soil. Prominent rings are seen both in the foreground and the background.
(Courtesy W. M. Ware and *The Gardeners' Chronicle*).



Photomicrograph of bulbils
(McG. Bulloch).



Single bulbil × 500
(C. J. La Touche).

ROBERT PATTERSON issues a warning .....

Confusing Cause and Effect

The other day my entry into one of our mushroom houses was met, with an unusual expression of glee from Arthur, who, with hose in hand, had apparently something worthwhile to tell me. On enquiring the cause of the joy, he took me to a section of a bed on the third tier and asked me to " have a look at that." Right enough the bed was just a mass of mushrooms, mostly large, although some were blown. My next question was, as he had anticipated, " How do you account for that ?" " Feel the soil," said he, " as dry as a bone." As it happened, Arthur had for some time now been advocating keeping the casing soil drier but I had insisted on sticking to the old rule " moist but not wet." To an outsider, Arthur's argument would have appeared convincing ; there was the dry casing soil and a good crop—nobody could contradict that—and on the remainder of the bed very few mushrooms and the soil was moist. It was with great difficulty that I attempted to explain to Arthur how he was mistaking cause for effect, and that instead of the dry soil having caused the good mushrooms that it was really the good mushrooms that accounted for the dry soil.

With mushrooms perhaps, more than any other crop, you find after a number of years that it is quite impossible to be dogmatic about everything. Your foreman will come to you and say that the sterilized soil is far better than the second spit because it happens to be better at the moment. Just before he suggests a wholesale change over to soil sterilization, a reminder about second spit having produced 3½ lbs. last year leaves him in a quandary with the wry smile and puzzled look which one might see on the faces of growers discussing mushroom problems around Frascati's cocktail bar.

We must all have found ourselves at one time or another advocating some method that gave excellent results and a listener will say that he had tried it without success but had had success with a plan which was practically the opposite of the one you had described. In Yorkshire, on one occasion, a fellow grower with whom I had been in conversation confided to me, " You know, if you wanted to write a book on mushroom growing, you should write it during your first year at growing." How true a statement that was. The longer we are at it, the less we seem to know.

I am convinced that the main cause of this state of affairs is that we are all guilty of that fatal mistake of growers, i.e., confusing cause and effect. Remember that small leggy mushrooms are the result of stuffy conditions and not the cause of it. Remember that a good run of mycelium in a bed will give the compost a dryish feeling and do not think that it was the dry compost which accounted for the good run. It is true that mycelium will run faster in a warmer bed, but the running of the mycelium itself is often the cause of the bed becoming hotter.

There are many such instances, so let us think twice when the next mushroom " axiom " stares us in the face.

Dr. C. J. LA TOUCHE gives us a glimpse of .....

SOME FRENCH MUSHROOM FARMS

In 1947 I decided to take my annual leave in May to visit a relative on the French Rivièra. So it occurred to me that as I was going to France, the cradle of mushroom culture, it would be a good opportunity for me to see for myself what was going on in the French mushroom-growing world. My friend Mr. McGregor Bulloch, who is now in charge of the magnificent Blandford mushroom farm in Dorset, was then at Pont-du-Château, near Clermont-Ferrand, growing mushrooms in an old dis-used Bitumen mine situated under a big hill outside the village. This being so, I decided to interrupt my return journey from Cannes to Paris at Clermont-Ferrand and to put in a day or two with him and the owner, M. Desnoues.

THE AUTHOR (*left*) WITH MR. BULLOCH

The mine was over a mile long but only the area covered by the first half-mile from the entrance was used for mushroom growing as that part which lay further in was flooded. It consisted of an irregular network of chambers varying much in dimensions but on the average about 40 ft. long by 20 ft. wide and 10 ft. high. The floors on which were laid ridge beds were not all at the same level. The beds were spaced about 1 ft. apart and lay in parallel rows extending along the greater length of the chamber. Each was sub-divided into three so that a cross-section showed three pyramids. The height of the pyramids was 1 ft. and their total breadth at the base, including the intervening furrows, was 3 ft. The furrows were raised a few inches from the ground by a layer of compost and casing soil and at the base on the outer side of the beds there was a low shelf of casing soil. The beds were not sub-divided by hand but were made in this pattern by packing the compost into a mould of the required shape and about 8 ft. long, and inverting it on the floor of the mushroom chamber, the process being repeated in series until a sufficient length of bed was formed.

The horse manure which was obtained from veterinary stables near Lyons was stacked outside, and after the second turn was introduced into the mine. The reason for this was to provide warmth in the mine. It was left near the entrance until the third turn, after which the beds were made up and left to undergo a fourth fermentation. When the internal temperature had fallen to about 90° F. the beds were spawned, but often they were spawned at 120° F. (internal temperature) in order

to effect a quick run. The spawn was planted in shallow pits about 8 inches apart in parallel rows : along the furrows, the outer base, and along the summit and sides of the ridges. The temperature of this mine was about 57°-59° F. throughout the year. The R.H. which was about 70% was maintained by watering the floors. Ventilation was effected by means of a shaft bored down into the mine from the surface. It was about 4 ft. in diameter and about 30 ft. deep. This shaft was considered inadequate, and at the time of my visit a second one was being bored. Pests were represented by springtails and long-legged mites. Fungus organisms were comparatively scarce, *Verticillium* spp. only being present. Fungus invaders were, however, conspicuous and were chiefly the white and brown plaster moulds.

My recollections of this mine are still illumined by the magnesium flare which we used in an attempt to photograph Mr. Bulloch who, Charon-like, navigated a canoe through its Stygian waters. I remember well also the warm hospitality shown to me by Mr. and Mrs. Bulloch, and the lavish entertainment provided for me by four generations of the House of Desnoues.

When I reached Paris, the Marquis de Drée was good enough to show me over his farm on the outskirts of the city. It was a dis-used subterranean limestone quarry. Long corridors led into large mushroom-growing chambers which in general plan resembled those at Pont-du-Château. The beds were also of the same type. The surrounding rock inside the quarry was an admixture of chalk and sand. It was ground on the spot to provide a fine granular casing soil. The horse litter which was used for the compost contained a large proportion of straw, and ammonium sulphate (6½ to 9 lbs. per ton of litter) was added to supplement the small proportion of droppings. This is common practice among French growers. The manure thus treated was put up in 50 ton stacks in a huge turning shed. They were about 1,900 sq. ft. in area and about 3¼ ft. high. The temperature in these stacks rose to about 165° F. and sometimes higher. In the quarry the atmospheric conditions were controlled in much the same way as at Pont-du-Château, but here there were more ventilation shafts and they entered the quarry usually at the junction of several mushroom chambers where large electric fans had been installed to facilitate introduction and distribution of the air entering through the shafts. Flies and mites (mite rouge) were abundant, but the flies were being controlled with D.D.T. The mites were so numerous that they formed a thick layer in the furrows between the ridges and here and there were collected into masses the size of a green pea.

The last farm which I visited was in a suburb of Paris and belonged to M. Germain Devaux ; M. Dekeirel, Secretary of the French M.G.A., and an Honorary Member of our Association here, accompanied me and introduced me to him. It was a dis-used gypsum quarry which had been farmed already by two generations of his family. It was composed of an upper and lower part. Owing to the surrounding cream-coloured rock being used for casing soil the whole farm looked very neat and

clean in the electric light with which it was illuminated. The lower floor, which was about 30 ft. below the upper one, was reached by a vertical iron ladder and M. Dekeirel and I felt quite giddy going down there. This quarry appeared to be singularly free from fungus diseases and pests were represented chiefly by a light brown springtail which though local in distribution was causing considerable damage to mushrooms by eating the tissue of the caps so that little punched out areas were formed.

Monsieur Dekeirel

Certain features are characteristic of French mushroom growing :—

Sites for mushroom growing :—These are usually dis-used subterranean quarries or dis-used mines.

Atmospheric conditions :—The temperature lies usually between 55° and 59° F. and is provided by the compost during the last stages of fermentation inside the quarry or mine. Ventilation is effected by means of shafts bored down through the roof. The relative humidity is about 70%.

Compost :—This is horse litter which is somewhat long in straw and to compensate for this ammonium sulphate is added to it.

Beds :—These are ridge beds cased with about 1 cm. of soil from surrounding rock.

Mushrooms :—These are picked closed and sold with the stalks entire ; as the casing soil is light and sandy in texture it is easily brushed off.

Yields :—The average yield is about 1½ lbs. per sq. ft. including stumps. Picking extends over from two to six months according to season and temperature.

Prices :—The average market price is about 2/6 per lb.

Extract from the Review of Applied Mycology.

Mummy Disease Reaches Europe

The mummy disease of mushrooms, described from the United States by Tucker and Routien, is here reported for the first time from Switzerland, and possibly from Europe. It develops for the most part towards the close of the growing season and is characterized by typical malformations and secondary bacterial invasion. The spread of infection is easily arrested by the isolation of the diseased areas and a contiguous zone of 2 m. on each side, either by means of trenches 10 cm. in width or by two wooden planks the same distance apart, which should be regularly disinfected.

Fleury, (C.) Une maladie du Champignon de Couche (*Psalliota campestris*) non encore decrite en Suisse : la momification. A Mushroom (*Psalliota campestris*) disease not yet described in Switzerland : mummification. Rev. hort. suisse 21, 10 pp. 2790282, 4 figs., 1 dia., 1948.

Mushroom Growing Practices in South Africa

BY

HILDEGARDE ROBERTSON

South Africa is a land of climatic variables : during the long months of summer the sun blazes over our rolling veldt, unrelieved, sometimes, for many months, by a drop of rain or a cooling breeze, the temperature frequently rises to well above 90° F. in the shade ; the winters, on the other hand, can be bitterly cold, while icy blasts from the South Pole tear across the dry, grey, countryside. The mild "mushroomy" climate of Southern England is quite unknown to us here except perhaps for a week or two during the early Spring rains or late Autumn rains—that is *if* the rains arrive, as long droughts are frequent, and it is not uncommon for boreholes and rivers to dry up. Any attempt at growing mushrooms in out-door ridge beds is thus doomed to certain failure and the same can be said of attempts to grow mushrooms all the year round in houses above the ground with ordinary insulation. The writer has personally met many persons who have risked substantial capital in an endeavour to establish the Mushroom Industry in South Africa, but the story is always the same : a lucky break or two in the Spring or Autumn and thereafter crop losses, site contamination, and all the pests and diseases common to overseas growers !

Mrs. H. F. G. Robertson

For many years the writer shared this experience with other growers, with the result that cultivated mushrooms were available to the South African public only as an occasional luxury. Gradually, however, plans were evolved for the construction of a plant, entirely below the ground, insulated and equipped in such a way that temperature and humidity control became a possibility. For the success of this plant the writer is indebted to Dr. James W. Sinden, of the Pennsylvania State College, who sent her the plans for a plant wherein the Tray System was explained and illustrated. This was some two and a half years ago ; these same plans were eventually published in the M.G.A. Bulletin No. 9. To-day we are producing over 6,000 lbs. of mushrooms every month throughout the year.

The writer has found the principal advantages of the Tray System to be as follows :—

1. It makes possible systematic all-the-year-round rotation.

2. Each growing shed will grow four crops instead of one or two a year—thus expensive insulation and refrigeration equipment becomes an economical proposition and is well warranted.

3. It is possible to keep production always at a maximum : that is, the production level remains steady, a given quantity of mushrooms being produced each day more or less. This is a great advantage in selling mushrooms, as customers know exactly what quantity of mushrooms they are going to receive in advance. We have achieved this result by watering our compost on a given day each month (first turn) and by filling one of the pasteurising rooms on a given day. Thus Heat Room No. 1 is filled on the 1st of every month ; Heat Room No. 2 on the 15th. The result of this attempt at standardization of practice is that we have a new shed coming into its first major flush every fortnight, and before its early vigour has in the least abated, the next new crop is already pinning heavily. Thus, over six sheds, our output from day to day and from month to month varies little. After the first flushes, the sheds usually settle down to steady production and thus further assist in evening up the daily output.

4. As the same amount of work has to be done each week, it is possible to employ a regular staff ; that is, one set of labourers for composting only ; one for casing ; one for watering, trashing, etc. In this way each workman becomes an adept at his job and greater efficiency is achieved. However, we are looking forward to the day when mechanization will largely replace native staff ; and in this respect too, the Tray System will be more competitive than older methods of growing, as mechanization will soon make it possible to produce a pound of mushrooms at a very low cost indeed.

We obtain an average of 2 lbs. per square foot from our trays. The compost in our trays is only four to five inches deep so the approximate yield per ton of manure would be about 200 lbs., but as we have never weighed the compost this is only a rough estimate. During the severe heat waves last summer our production fell to about 1 lb. per square foot, whereas now, when the outside temperature in the early morning is 30° and the boiler has to be kept going for twenty-four hours each day, we find our production as good as two and a half and from many trays even three pounds per square foot. One reason for this is that in summer humidity control is virtually impossible (despite our underground sheds) whereas in winter we allow live steam to trickle into the growing sheds, which results in beautiful plump mushrooms and plenty of them !

The trays are allowed to crop for only 72 days and by that time the mushrooms have pretty well exhausted the food material in the four inch depth of manure. The only way to increase production would

be to add more food to the compost, and in this respect I have found the article on synthetic compost in the latest bulletin very helpful as it gives one a good idea of how to reinforce the food requirements of the mushroom in a poor compost, as all our horse manure and wheat straw in South Africa is of poor quality as compared to yours.

Contrary to practice in England, we use only racing stable manure in our plant. In South Africa most horses are allowed to graze on the veldt and are only stabled at night, racehorses being the only exception. We find that grass-fed horses yield a poor compost, so that racing stable manure, although long and strawy, has better possibilities. We have found a way of overcoming the disadvantages of racing stable manure and of enriching it in a way that will give maximum yields. This is how we handle it : some forty tons are assembled in a long rick, long straw is added (our South African straw is so brittle that it breaks into small pieces in the stables) also about 40 lbs. of gypsum to each ton of manure. Then during the next few days a tanker from a nearby abattoir pours over the compost some 10,000 gallons of blood and water (about one third blood). The compost is drenched ; the leachings drain into a concrete pit and are promptly pumped back onto the compost again. The blood makes the compost more dense and compact and hastens fermentation ; our composting period has thus been reduced to about 18 days from the time the blood is applied ; the material loses little bulk and much food value is added. When we have omitted the blood from composts a marked reduction in crop was experienced. In winter time we compost the manure on a " horse "—a long triangular steel structure designed to admit air to the central core of the pile : in summer, however, we find that the manure dries out too much if this is done.

The problem of obtaining fresh spawn for our plant has been one of the major growing problems in our country. There are no spawn makers in South Africa, and much of the spawn imported from England or America dies in transit through the tropics, so that one can never be certain whether spawn will grow. We have frequently spawned all six hundred trays in one of the pasteurising rooms, only to find that no growth at all was made and that there was no spawn in the country to save the crop ! Under such circumstances, we have had to resort to the practice of using spawn out of the growing trays in the adjoining heat room. This spawn, of course, is not a pure culture, and as we have had much trouble from Brown Plaster Mould, we have had to find a method of getting the trays filled with mycelium in one week—before the mould could germinate. To do this, we cover the surface of each tray with wet spawn, saturate the room with moisture, and keep the temperature just below 70° F. If the temperature is allowed to rise to 80° F., or near it, the mould germinates and takes possession of the compost before the spawn has grown down into it. Usually, however, we grow the trays solid with mycelium in a week to ten days and when the mould germinates there is no compost left to invade !

To date we have found no suitable sub-soil for casing mushroom beds : most South African sub-soils are of poor texture : surface soils,

on the other hand, are full of fungus diseases : Truffle, Mycogone, Verticillium, Moulds, Mildew—we are familiar with every one of them! In order to sterilize casing soils rapidly and economically, the writer has invented a soil sterilizer which may be of interest to growers overseas. We call it the " See-saw " sterilizer, and it is operated on the same principle as a dump truck. An oblong frame or box is constructed to hold about 2 cu. yds. of soil ; this is fitted to a stand and balances like a see-saw. A coil of perforated pipes is fitted and attached to the bottom of the box and this is connected to the boiler. At the further side of the sterilizer a hole is dug about three feet deep with sloping sides, large enough to hold the quantity of soil to be sterilized. The sterilizer is filled with two inches of cinders and one foot of moist soil and the steam is turned on. When 175° F. is reached just below the lid, the soil is dumped into the hole by opening the end flap and tilting the frame or box. The soil is immediately covered with a tarpaulin and the sterilizer is re-loaded. When all the soil has been sterilized the hole is covered with a tarpaulin, bags, boards, anything to produce a sweat. A temperature of over 170° F. is thus maintained throughout the soil for more than six hours—the killing being completed while the soil is sweating. As an added precaution, we sometimes fill the boiler with a 2% formaldehyde solution and inject the vapourised gas with the steam, but this is not necessary.

My husband and I intend to visit England in the Spring next year and we certainly look forward to seeing the Research Station and to meeting all the growers who have done so much for growers the world over by forming the Mushroom Growers' Association. In a far-away country such as ours you have no idea with how much pleasure one anticipates the arrival of your Bulletins.

Mrs. M. H. PINKERTON in controversial mood .....

Let's Grow Morels !

Jaded, perhaps, after an extensive review of all the attempts which have been made to find a synthetic compost for mushroom growing, it has occurred to us rather forcibly that perhaps our efforts are misdirected.

Botanists never tire of pointing out that the cultivated mushroom resembles the field mushroom and haystack mushroom in appearance only, and that the cultivated mushroom is an individual species which occurs naturally in horse manure. They base this theory on the fact that while the field mushroom and haystack mushroom bear four or three spores on each basidium, the cultivated mushroom is a two-spore bearing variety. The theory is certainly strongly supported, first by the point-blank refusal of the field mushroom and haystack mushroom to grow in a compost containing even a trace of manure, and secondly by the fact that the only two-spore-bearing varieties which grow wild are found in old manure heaps or on heavily manured land.

In the light of these arguments, it would seem that the experimenters have chosen the one mushroom which prefers to grow on horse-

manure and have set to work to persuade it to change its habits, blandly ignoring the fact that there are countless edible mushrooms which grow from choice on purely vegetable matter and have not the slightest interest in the vanishing horse.

The next step in our heresy was to decide which wild mushroom we should attempt to grow. The obvious choice was the haystack mushroom, partly because most synthetic composts are made on a foundation of rotted straw—the material on which the haystack mushroom grows naturally, and partly because Miss Dorothy Cayley has already succeeded in cultivating this mushroom in boxes and in germinating its spores, so that the initial steps of research have already been taken.

We rejected the haystack mushroom for several reasons : (1) that the caps are not tough and would not travel well, (2) it is not an improvement on the present cultivated mushroom and therefore would not justify the immense research that would be necessary to make it a safe investment for the grower, (3) its reputation is not so great that the public would be tempted to buy it.

Our next consideration was the " Oyster " mushroom which grows on trees and might be expected to have a lot in common with the " shiitake " mushroom which is cultivated extensively in Japan. Again we discarded the idea, not because the methods of cultivation must obviously be entirely different from those with which the grower is familiar, for I am sure the British mushroom growers could soon adapt themselves to growing crops on logs, but because the timber supply is no more satisfactory than the manure supply and we should simply be switching from one shortage to another.

Ultimately, a study of the fungi that grow wild in Britain leads us inevitably to the " morchella deliciosa." The advantages of chosing this variety are many. In the first place the morels have such a world-wide reputation for delicious flavour that even those who have never seen any have an ambition to taste them to see what they are like.

In the second place, all the varieties of the morel are edible and are so distinctive in appearance that they could never be mistaken for a poisonous kind or vice-versa. Consequently people would eat them with confidence, without the misgivings they might feel towards any other unfamiliar fungus.

The third advantage lies in their name, for while the public might be bored at being asked to buy a new type of mushroom—the haystack mushroom, for instance—they might conceivably be intrigued at being asked to buy a " morel."

The fourth consideration is that the morels dry well, so that transport difficulties would be negligible. If the crop could not be despatched at once, it could be dried and kept till wanted.

The chief advantage, however, lies in their fructifying habits. Growing out of the earth as mushrooms do, it is probable that they could be cultivated in the present commercial mushroom houses and should manure become scarce, a few houses could simply be turned over to the production of morels.

The idea of setting out to discover the secret of morel culture may seem rather ambitious, but with the scientific facilities now available to the " growing world ", it is not unduly so. It is undeniable that if as

much intensive study had been devoted to morel culture as has been devoted to synthetic composting, we should now be growing them on the house-tops.

What has been learned about the habits of the morels is encouraging. They are usually found in clearings in woods, and are particularly fond of oak trees, elm trees and old apple orchards. A photograph in one book on wild mushrooms shows a large crop of morels growing on a bed of leaf mould—which probably explains their preference for woods. Sometimes they are found under hedges or on the banks of a stream which may mean that they like both shade and moisture.

Soil can be either clayey, chalky, sandy or gravelly, but is seldom sandy and most often clayey. Chalky soil suggests the addition of gypsum to the compost.

Morels appear in wet weather in early spring and on rare occasions in late autumn. The rainy weather suggests that watering would be necessary to bring the crop on and the season indicates that artificial heating would probably not be required.

One peculiarity which has been learnt about the cultivation of morels is that they appear abundantly on ground which has been burnt over. So much so that peasant women in parts of Germany made a practice of burning the land to encourage morels and large tracts of valuable forest were destroyed. Eventually the starting of fires had to be prohibited by law.

That the burning does encourage the crop is borne out by the fact that morels often appear on ground where charcoal has been burnt or where cinders have been thrown, but what part the burning plays has yet to be investigated. Does it provide a top-dressing of wood ash and burnt vegetable matter that encourages morel growth? Or does the heat destroy other bacteria and fungi in the soil and so give the morel a chance to develop? Or does the fire provide composting conditions at high temperature in the soil? Perhaps all these possibilities contribute to the crop.

Disturbed ground, such as bombed and shelled areas in France, often produces morels, but here again the heat generated by the bomb or fires started by the bomb may have had something to do with it. Charred paper and burnt rubbish are also listed as having produced crops.

Another strange piece of information is that morels have grown on the apple pulp refuse thrown out from cider factories—an encouraging thought for growers who live in the southern counties. The apple pulp, in conjunction with the morel's fondness for old apple orchards, offers a definite line of investigation. An analysis of the apple pulp, its pH, etc., would probably be enlightening—and also a knowledge of what processes the pulp had passed through before being thrown out.

It looks then as though morels grow at low temperatures on soil which has been sterilized or composted at high temperatures and covered over with a loose top-dressing of leaf mould or wood ash or both. If such is the case they are eminently suitable for cultivation and the problem should be studied.

Having got thus far, let us hasten to say that we do not propose to carry out this research alone. We are not that clever. What we suggest

is that those who find the morel growing wild near their homes should study its habits and report their observations to the M.G.A.

Questions which must be answered are :—

(1) How deep into the soil does the mycelium grow—information which would tell the grower the best depth to make his beds.

(2) In what type of soil is it growing—chalky, sandy, clayey or gravelly? Is the soil wet, dry or moist, sticky, close-packed or well aerated? Is it full of root fibres?

(3) Has the ground ever been burnt over or had a fire built on it? If so, how long ago?

(4) Do morels ever grow on the Scottish moors after the heather is burned?

(5) Has the earth a top dressing of leaf mould or wood ash? Analysis of a sample of the soil in which the mycelium is growing would indicate what the morel requires in the way of food, pH, moisture, etc.

As to the morels themselves—How long do they crop? How many pounds to the square foot do they produce? What kind of weather do they prefer? Cool, sunny, wet, dry, sultry, humid? What is the prevailing temperature during the day and at night during cropping? What kind of weather preceded their appearance during which time, presumably, the spawn was growing—or does the spawn perhaps run in the autumn after fires started by summer droughts, lie dormant during the winter and produce morels in the spring? And does this account for the occasional rare appearances of morels during mild weather in late autumn? Does the crop suffer from disease or insect pests? —though even if it does it's a cinch it doesn't suffer from as many as the cultivated mushroom is heir to! Have you ever seen morels growing on apple pulp and if so, under what conditions? In other words, what do you know about morels?

These are questions to which only widespread observation throughout the countryside can give the answer and, by pooling the scraps of knowledge which must exist among country people, a basis for experimental culture could be provided. The Scottish Mushroom Laboratories offer all the facilities at their disposal to carry out any tests that the growers might like to make, and the results could be made public through the courtesy of the M.G.A.

In appearance the morels are unmistakable. They are usually from 2-6 inches high though one variety, the morchella crassipes, has been found growing to a height of 1 foot. The cap is usually twice as long as the stalk and is hollow. When young, it is a buff-yellow which deepens with age to tan or brown. The surface is deeply honey-combed or pitted and spores are borne both in the ridges and in the depressions.

The stems are stout, brittle, hollow, white or whitish, and grooved at the base. In some varieties the stem joins the cap at the rim, in others it is attached only at the apex.

The only poisonous mushrooms with which the morel might be confused are old stinkhorns whose greenish spores have been eaten off by flies or washed off by rain, or the Gyromitra esculenta, which is convoluted like a calf's brain, not pitted or honey-combed. The resemblance is so slight as to make mistakes extremely unlikely.

PRESS CUTTINGS

Why, it has been asked, with potent **insecticides** like D.D.T. and B.H.C. available, should time be given to the examination of other insecticidal compounds which have been introduced, apparently, only for reasons of commercial competition? The answer lies in the danger that the widespread use of one insecticide or of insecticides similar in their modes of action will result in the unwanted selection of resistant strains of insect pest . . . . . Variation in the resistance of individual insects of the same species to the action of an insecticide is a well-established phenomenon . . . . . (One suggestion) is the use of a second insecticide different in mode of action from the first and to which the insects resistant to the first are susceptible . . . . . But the combination of the two compounds might still be much more effective than either alone—an increased efficiency distinct from synergy.

Dr. H. Martin, in *N.A.A.S. Quarterly Review*, Summer, 1949.

While **timber** is scarce, there are 1,224 timber controllers, according to a recent Parliamentary reply by Mr. Wilson, President of the Board of Trade. Their salaries total £593,000 a year. The estimated number engaged in the trade is 86,700, which gives an average of one controller to every 71 employed. *Daily Telegraph*, 9.8.49.

Mushroom growing is well suited as a sideline for poultry keepers, as it occupies very little space. Poultry manure is, however, of no use for the cultivation of mushrooms, and some good horse-manure will have to be obtained by those who wish to grow this crop. There is no doubt at all that mushrooms are a profitable crop to grow, if the experiment is **successful.** One grower has taken over 600 lb. of mushrooms per week from a bed of 600 square feet in area.

J. W. Morton, in *Poultry & Poultry Husbandry*, 9.3.34.

Members of the Berks. Horticultural Branch of the N.F.U. are against the introduction of an organised **marketing scheme** for vegetables. The Branch recognised the vital importance of grading, packing and publicity which, it was said, the natural process of evolution would ultimately enforce on the industry.

The Nurseryman & Seedsman, 21.7.49.

Professor Laurence Sloss, American scientist, says **horses** will disappear in time. But not for another 15,000,000 years.

People, 20.3.49.

Ethel Griffies, the actress they are calling Britain's Mistinguett, to-day talked about the secrets and the technique that have made her, at 70, the most talked-of woman on the American stage . . . . . Be careful about what you eat, says Miss Griffies : . . . . . I like **mushrooms,** lamb chops, French beans and fruit. *Daily Express*, 21.7.49.

British Railways are carrying out trials with electrically-driven **" mechanical horses "** which, it is expected, will replace the 7,000 horses now used for road transport deliveries. *Daily Telegraph*, 19.5.49.

Mr. W. C. Moore, M.A., has been appointed to the post of Director of the Plant Pathology Laboratory of the Ministry of Agriculture and Fisheries at Harpenden. *Gardeners' Chronicle*, 18.6.49.

We have been experimenting this year with mushroom compost made with **poultry manure** and it has turned out extraordinarily well. I don't know that the crop will turn out as heavy as on horse-manure.
" John Fallowfield," in *Fruit Trades Journal*, 11.6.49.

Eleven-inch mushroom pushed its way through the hard asphalt floor of a factory boiler-room in Richmond, Australia.
Grower, 11.6.49.

Under the current Wages Order a worker is entitled to seven days **holidays-with-pay** when he has completed 12 months work with the same employer. It has been agreed at Wages Board level that a complete week's holiday from Monday to Saturday ranks as six days holidays-with-pay. *Essex Farmers' Journal*, June, 1949.

The party moved to four large Norfolk reed thatched glasshouses now being used for mushroom culture ; here composting, laying down the beds, spawning and casing were in progress, under exceptionally clean conditions. Mr. (Edward) Sparkes stated that this was an attempt to " use up " **surplus manure,** and this gave rise to numerous questions by the visitors. *Nurseryman & Seedsman*, 11.8.49.

Compost made from organic waste such as garbage, sewage sludge, corn stalks, straw and waste from sugar plants and fisheries can be processed **in five days** by a new method evolved by the President of the American Kaiser-Frazer Corporation. The decomposition of the material takes place in a 3,000 cubic foot fermentation plant called a " digester," and through the induction of biological stimulants and proper aeration and heat, the process is speeded up. *Fruit Grower*, 11.8.49

Acknowledgement : The photograph of Dr. Edwards and Dr. Bels on the Research Open Day (page 140 of Bulletin 16) was taken by the staff photographer of the *Peterborough Citizen and Advertiser.*

MEMBERS' ADVERTISEMENTS

FOR SALE. Composter, Elevator type, cost £250 ; also Soil Riddler, cost £80. Both machines in new condition and having received several improvements on the originals. Offers to :—Stone Lodge Mushroom Farm, Tenterden, Kent.

CORRESPONDENCE

ALKALINE, Mr. HARDING ? I read Mr. Noel Harding's article on Thin-Stemmed Mushrooms (M.G.A. Bulletin 16) with interest, but on p. 144, he says " Mycelium will run best in an alkaline soil—pH 7 to 7·5". I feel this statement will tend to confuse the already bemused pH fans as to what constitutes an alkaline condition. True neutral is, I believe, about 7·07 anyway, but, apart from that, between 7 and 7·5 could hardly be called alkaline as applied to casing soils. Do you agree ? I should call any casing between 6·5 and 7·5 approximately neutral, with a corrector called for if the pH is at the outside edge of these limits (if one wants to be exact). McG. Bulloch.

A MONTHLY BULLETIN ? I feel that the more urgent matters reported in the Bulletin should not have to await quarterly publication but should be passed on to members at once by the aid of printed circulars until such time as the Bulletin can appear more frequently. I should like to see a monthly publication in the same high standard of quality as soon as the Association can afford it. W. A. B. HARDING.

I like the M.G.A. Bulletin more and more. You started a good thing and it certainly seems promising from this distance. McGregor Bulloch's article in the July issue was excellent ; I am impressed with the possibilities inherent in the soil tensiometer.

DR. A. M. KLIGMAN.

FANCY GRADING AND FANCY YIELDS ! When we started cultivating mushrooms in our Shawl Factory in the year 1931, we got our own registered trade mark and graded our mushrooms in this way : Large Closed Cups, Large Open Cups, Flats, Small Closed Cups, Small Open Cups, Very Small Closed Cups and Very Small Open Cups--all in separate baskets. This method swallowed a lot of the packers' time, so we ended it, and started grading Large Closed Cups and Large Open Cups together in the same basket, Flats by themselves, Small Closed Cups and Small Open Cups in the same basket, Very Small Closed Cups and Very Small Open Cups in the same basket—and that way of packing brought in the same money. One firm wanted all the closed cups at less money than we got in the wholesale market. We sometimes get more money for the Flats, which in our opinion are nicer eating than the others. Our registered trade mark sells our mushrooms without the string-tied basket being opened. We leave the fancy packing—the measuring of mushroom heads and stalks—to the marvellous conjuring growers who get from 1¼ lb. to 4 or more lbs. per square foot ; we get very often no lbs. to the square foot, only ounces, diseases, pests, insects, grubs, etc. It would be very interesting to see such growers' certified balance sheet of square footage, quantity of mushrooms sold and price for 12 months ! Miss Duncan, M.R.A. microbiologist, shows specimens of mushrooms attacked by 11 different diseases—Mr. Atkins adds on his eelworms—what have the entomologist, bacteriologist, biochemist, analytical chemist and the Research scientific inquiry investigators to say ? I hae ma doots ! JOHN BEVERIDGE.

LABOUR COSTS IN AMERICA. Your April Bulletin was as always a welcome contribution to my reading. Among the articles that particularly interested me were Mr. Atkins' analysis of costs and the report on synthetic compost from the Research Station. The cost of labour as reported by Mr. Atkins would be entirely prohibitive here, especially as the wages paid are nearly if not quite twice as high as those in England. Naturally, there are few growers who keep accurate record of costs and of these only a handful are willing to reveal their records. The accounts I have access to show very much less spent for labour, even in the plants growing mushrooms by the bed method. I shall try to get together some comparable figures to send you.

DR. JAMES W. SINDEN.

EXTRACTS FROM A MUSHROOM GROWER'S ★ DIARY ★

June 17. Spent the day with Dr. Storey, Plant Pathologist of N.A.A.S. on a visit to a grower in difficulty. I was most impressed with the Doctor's knowledge of practical mushroom growing and his admission of ignorance where knowledge stopped short ; also his dogged persistence and painstaking patience in trying to solve the problem. If his interest in and attitude towards mushrooms are typical of all N.A.A.S. officers—and after all it's only one small branch of their study—we can soon hope for sincere and able advice from this new service.

June 18. Yesterday's problem (mentioned in last Diary notes) was one of vanishing spawn. Storey and I decided compost was underdone and that insufficient food was available to feed the vast amount of growth that had early filled the casing. There was no insect or detectable disease damage. Is it not reasonable that too short a composting period leaves each straw with a limited amount of " food " and if the compost is also dry the mycelium will ultimately die off and vanish ?

June 20. Thoughts on Composting prompt the question : should there not be some standard when reference is made to composting " turns." I find my " 4th turn " is someone else's " 3rd." My " 1st " is another's " stacking." It leads to confusion. The trouble is at the start. If dung comes in over a period and is " stacked " as it arrives it is surely sensible to describe as a 1st turn the process of turning and aerating and watering it from that stack the first time. On the other hand if the arrivals are just dumped anyhow, the first shaking, aerating and watering make the first properly shaped stack, a process justifiably called " stacking." It looks as if *I* shall have to give way and my future 4 turns will mean 5 the old way. But if I make it 4 and call it 3 I shall be accused of under-composting !

June 30. If these notes are deemed unhelpful, here's a hint. If you want to try out a new soil put it on top of some fresh moist spawn (as purchased) in a jar. A warning : if you get one clump weighing 1 lb. from roughly ·1 of a sq. ft. it doesn't necessarily follow that your commercial yield from that soil will be 10 lbs. per sq. ft. !

July 1. How far have we advanced in 16 years ? In 1933, Styer wrote : " Selection and preparation of soil is not yet given the attention it deserves." And still *not yet* in 1949. I honestly think we have more to learn about soils than composts. How many of us miss the maximum available in our composts because we don't understand our soil and its management ? The other day I heard two scientists discussing the problem of soil watering. They admitted after half-an-hour of technical jargon, highbrow and abstruse expressions, that all they had said could be summed up with old timer " not too wet and not too dry."

July 5. Shocking prices. Starting early and two or three months to go !

July 6. I wonder how much harm this hot spell is doing us. Certainly the fruiting of mycelium is being retarded. I'm afraid we shall suffer for it later—when we've forgotten the cause.

July 15. The chief virtue of Mac. Bulloch's article on watering in the current bulletin is that it ventilates the problem. I don't think for a moment his soil tensiometer is a solution. It would take years to find out the correct readings to aim at. And what about those desirable alternations of dry and moist conditions which seem to be demanded by both plants and fungi ? How would the instrument help when we don't know precisely what we want ? Bulloch fails to include in his " snags " the most important—the tensiometer devised would only give the average reading of the soil layer. A ½ inch of surface saturation with a perfectly dry ½ inch near the compost would be averaged by the " cup," giving perhaps an ideal reading—but with a dry point of contact would there be any mushrooms ? One can, however, be grateful that someone is doing some constructive thinking.

July 16. The theory of cold air contacting hot beds causing fruiting sounds attractive and mechanically (or electrically !) simple. I've a feeling the theory is too frequently confounded in practice.

July 18. Whence, with three legs of the horse in the grave, this seeming glut of stable manure ? (See adverts in press, telephone, " Ideal for Mushrooms " travellers in Rolls Royces, etc.)

July 26. Week-end prices avalanched to as low as 1/3 for good quality. Some salesmen admit to subsidising the price by as much as 6d. per lb. for fear of losing their senders.

July 27. Prices lift slightly but average must be discouraging to a beginner.

August 12. In this month's *My Garden :* " Many do fear the goodly musherooms as poysonous damp weeds ; but this doth in no ways abate the exceeding excellence of God's providence, that out of the grass and dew where nothing was and where onlie the little worm turned in his sporte, came as at the shaking of bells, these delicate meates." From an old Herbal.

August 14. There is in my ofrice a photo frame. It's not mere coincidence that when certain people visit me, the first thing they see is their own picture. You'd be surprised : it works like the " soft word." I would add the frame takes whole plate enlargements, so if you intend visiting me, send your photo first !

August 15. One of my salesmen phones me the fields are white and he has to compete with lorry loads of " wild " at 6d. per lb. I hear they are 3d. in the Lake District.

August 16. Secretary Watson and indefatigable writer Atkins here to-day, ostensibly to help me over a pinhead problem, which seems to be bound up with hot weather effects. Sum total of advice—the purchase of expensive air-conditioning plant. Thank you, gentlemen, but not at two bob a pound.

August 17. Just finished reading the manuscript of Atkins' book on Mushrooms to be published, I understand, next spring. It makes lively, constructive and non-technical reading. It is admirably compiled and treats the subject from A –Z. It is in fact so comprehensive that I predict it will almost rival the so far unequalled "34." All subjects are discussed logically and from the grower's rather than the outsider's angle. It presents practical problems and offers practical solutions. Inevitably F.C.A. admits the confusion, contradictions and uncertainties of the business, but nowhere is he ambiguous. He caters for all growers from beginners to old stagers and at the same time provides a readable book for the layman, who will be amazed to discover that cultivated mushrooms don't exactly "just grow overnight." To be copiously illustrated, I believe.

August 20. Squirrels, they say, are very fond of mushrooms. We too find them a hard nut to crack.

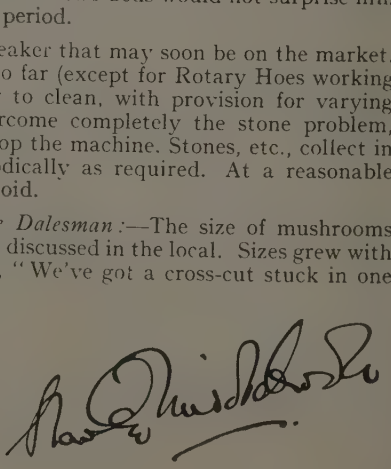
August 22. The continuing hot summer is playing havoc. Ventilation in my "Handcrafts" is so completely upset that only the top beds will produce properly. In winter the top beds are worst. Circulation of air by the Heating System in winter seems fairly ideal, but there is no summer equivalent. Fans would tend to channel the air, unlike the even distribution from long water piping. It is a case perhaps of too-efficient insulation—no creepage of air through the sides of the house. In this respect Onazote lining is the worst summer offender, being a complete and absolute seal. It's probably still the best in winter.

August 24. The tray system seems to be becoming more widespread. I must be old-fashioned. I still see more snags than advantages.

August 30. Visited M.R.A. and learned from Dr. Edwards that his latest synthetic tests are very promising. One group at least looks like being over the 2 lb. mark, while one or two beds would not surprise him if they reached 3 in a 12 week period.

September 1. Inspected a soil breaker that may soon be on the market. It's the most effective I've seen so far (except for Rotary Hoes working the soil before collection). Easy to clean, with provision for varying screen sizes. It still hasn't overcome completely the stone problem, but such hard matter does not stop the machine. Stones, etc., collect in the base and are removed periodically as required. At a reasonable price this machine should fill a void.

September 2. Adapted from *The Dalesman*:—The size of mushrooms picked on various farms was being discussed in the local. Sizes grew with the pints, till finally one averred, "We've got a cross-cut stuck in one at home."



Water and Mushrooms

By

S. BURROWS, M.R.A. Research Chemist

Water is such a widespread and commonplace material that it is usually taken for granted and it is not realised that it has some remarkable and unique properties. The higher density of water compared with the ice formed from it is a peculiarity which is accepted without wonder and although of no great importance to mushroom growers is of vital importance to the fish in the sea. Water takes a great deal more heat to raise its temperature than any other common substance, so enabling an equable temperature to be maintained in many parts of the earth and assisting in doing so in our bodies and in mushroom houses. The high specific heat, as this property is called, is somewhat of a drawback, however, when peak heating, since nearly all the heat required to bring up the temperature of the house to the desired level, leaving out of consideration the heat lost (which may be large), is used merely in raising the temperature of the water in the compost. Very little heat is required to warm up the air, the material of the house and the beds and the dry matter in the compost.

But we cannot dispense with water. It is an essential part of all living matter and its unique properties fit it perfectly for the various jobs which it has to do in controlling and maintaining life. Water plays a part in many of the chemical reactions and reaction chains which are continually proceeding in all living organisms, sometimes being used up, sometimes being formed and sometimes, to all appearances, remaining an unconcerned spectator, but in actual fact assisting a reaction to take place which would not have done so if the water had been absent. Water also acts as an inert medium in which these metabolic processes may take place, and helps, too, to maintain the correct physical condition of the proteins of which living matter is built. Some consciences may have been troubled by complaints about the high price one has to pay for the water contained in mushrooms, but peace of mind is restored when it is seen that we cannot have mushrooms without water. Indeed, most delectable foods have a high water content as is evident from the following table.

	apples	beefsteak	runner beans	bananas	cream	celery
% water	85	62	89	75	74	94
	whole egg	oysters	strawberries	cooked peas	tomatoes	mushrooms
% water	74	87	90	80	93	91

The chemical formula for water is usually written as H_2O, that is, one molecule of water contains two atoms of hydrogen and one atom of oxygen. This may represent the state of affairs for steam at high temperatures, but water at ordinary temperatures is actually more complex and is a mixture of " monohydrol " H_2O, " dihydrol " $(H_2O)_2$, and

" trihydrol " $(H_2O)_3$. Water can associate itself with other materials in a variety of ways and the association may be a loose one or a firm one depending upon the nature of the material. This is illustrated by the drying out of soil. When wet soil is allowed to dry in air the " free " water is lost first. This water is not attached to the soil and may also be removed by drainage without pressure or suction. Next comes the " capillary " water which is retained in the minute channels and cavities by feeble capillary forces. Under very arid conditions the more strongly held " water of hydration " or " bound water " may then be removed. This is held by the colloids which form a large part of clay soils, and which bind the water so tightly that it cannot move and does not function like free water. If this dry soil is now heated, more bound water may be removed and finally at temperatures well over the boiling point of water combined water is set free. This last is not originally present as water but forms an integral part of the minerals in the soil. These degrees of association are not clearly defined but there is a gradual transition from one to the other. The moisture holding and moisture retaining properties of soil will depend on which type of association predominates, which will in turn depend on the texture of the soil. Thus one soil may hold a good deal of water in its capillaries but if it contains no clay colloids it will quickly lose its water by evaporation, whereas a heavy clay soil will take up water and also retain it well.

In a similar manner the water in compost may be divided into free and bound water although less is known about the forces which operate in retaining the moisture. The structure of the organic matter in compost is, however, more delicate than that of the minerals in soil ; so much so that a slight drying out of compost alters its structure and lessens its ability to re-absorb moisture when again wetted. This ability may be fully recovered after some days in contact with water but the lag is a serious matter at the end of composting, and a compost which is on the dry side cannot be brought back to prime condition by the addition of water. The great differences in texture between heavy horse manure compost on the one hand and racing stable compost or synthetic compost based on straw on the other hand results, in the same way as with differences in soil texture, in variations in moisture holding and retaining properties. For this reason a laboratory determination of all the moisture present is far less satisfactory than the usual hand-squeezing test performed on the spot.

Articles and notes on watering have been numerous in these Bulletins and no apology is offered for this, yet another incursion into the same field. The subject is a difficult one and only by continual discussion of its various aspects can we arrive at any basic ideas which will guide us in practice. Because of wide local variations the grower can probably help himself at the present stage far more than the laboratory researcher can help him. Thus Bulloch's soil tensiometer described in Bulletin 16, p. 134, which should soon be generally available, may be of considerable assistance in gauging the watering of beds correctly.

It is hoped in a further article to say something about the movement of water in mushroom beds.

B.H.C. AND MUSHROOM PESTS

A PROMISING MEANS OF CONTROL

BY

G. J. SHANAHAN, B.Sc.Agr., Assistant Entomologist, New South Wales Department of Agriculture.

More effective methods of controlling the main mushroom pests, namely, mites (*Tyrophagus putrescentiae*), springtails (*Collembola*) and flies (*Sciara* sp.), are required. These pests can become troublesome when mushrooms are produced in the warmer months, and may actually be limiting factors in mushroom production.

Once mushroom beds become infested with insects and mites it is practically impossible to control them by the present available measures, which include spraying with nicotine sulphate or kerosene-pyrethrum fly sprays and fumigation with sulphur. In recent years some growers have been using the blow lamp to reduce the infestations of mites and springtails but serious damage to both the mushrooms and the mycelium can follow unless the beds are flamed over correctly.

Tests with B.H.C. indicate that this chemical is promising for control of these pests and that despite the characteristic musty odour of this chemical, beds can be treated with the toxicant without causing a foreign flavour to the mushrooms or interfering with production.

The possible value of B.H.C. for controlling mushroom mites was recognised when laboratory tests by the writer showed that B.H.C. dust was toxic to *Tyrophagus putrescentiae*, a Tyroglyphid mite which is often found in mushroom beds during the warmer months.

Before an experiment with B.H.C. against mushroom mites was conducted, Tarsonemid mites (probably *Pigmaeophorus americanus*, apparently previously unrecorded here) appeared in commercial growers' beds at St. Mary's. The mites were present in plague proportions, forming colonies on the surface of the beds, and massing on clumps of the casing soil. It is reported* that this mite will not damage mushrooms, but feeds on the mycelium and hence can reduce or delay mushroom development.

The Tarsonemid mites practically disappeared from a bed which was dusted with 10 per cent. B.H.C. dust at the rate of 1 oz. to 6 square yards, whilst undusted beds remained infested with mites. Mushrooms, in the button stage, were present at the time of dusting and did not appear to be affected. When mushrooms in various stages of development were dusted at this rate to determine whether the B.H.C. dust would affect their appearance or flavour, no foreign flavour was detectable in the cooked mushroom but a slight " burn " was noted on the dorsal surface. However, when mushrooms were deliberately over-dusted the " burn " was easily noticeable in freshly picked mushrooms and might possibly detract from their market value.

A 20 per cent. B.H.C. dust which was applied at the rate of 1 oz. per 40 square feet successfully controlled the Tarsonemid mites, which appeared in limited patches in some 5,000 square feet of mushroom beds.

As Tyroglyphid mites (mainly *Tyrophagus putrescentiae*) are

usually the most serious mites associated with commercial mushroom growing, a preliminary trial was conducted with the same growers at St. Mary's to determine the value of B.H.C. in preventing their occurrence, and to observe further whether this chemical would interfere with mushroom development. The trial was carried out in a brick building.

The experiment consisted of plots (9 feet × 4½ feet) which were dusted with either 2 oz. or 4 oz. of 10 per cent. B.H.C. dust. In addition 16 oz. of the dust were incorporated into the compost of a bed of similar size. Approximately 2½ cwt. of compost were placed into each plot which formed a flat bed of the dimensions given above and 4 inches deep. Each treatment was duplicated. The dust was applied with a screw-top jar with perforated lid. The casing soil was added about a week following treatment. Two control plots of similar size were kept.

Tyroglyphid mites were practically absent from the treated beds, but since the mites did not appear in large numbers in the control beds, no conclusion can be reached from this test concerning the value of B.H.C. for Tyroglyphid mushroom mite control. However, the B.H.C. dust did not appear to inhibit the growth of the mushroom mycelium or to interfere with mushroom production or to cause tainting.

The effect of B.H.C. on springtails (*Onychiurus ambulans*) was also noted during this work. Springtails were immediately affected when beds bearing infested mushrooms were treated with a 20 per cent. B.H.C. dust at the rate of 1 oz. per 40 square feet. Live springtails were absent from the surfaces of previously infested beds 24 hours after dusting with B.H.C.

In sections of the mushroom establishment, where the surfaces of the beds had been treated with 20 per cent. B.H.C. dust, at the rate of 1 oz. per 40 square feet, adult mushroom flies (*Sciara* sp.) were noticeably reduced.

The 10 per cent. and 20 per cent. B.H.C. (benzene hexachloride) dusts, which were used in this investigation, had a 1·3 and 2·6 per cent. gamma isomer content respectively.

*Thomas, C. A., "Mushroom Insects—Their Biology and Control." Pennsylvania State College Bul. 419 (1942).

(*Reprinted with permission from the N.S.W. Agricultural Gazette, Misc. Pub. No.* 3335, *April,* 1948.)

Editor's Note: B.H.C. is better known to growers in Great Britain as Gammexane.

PUZZLE CORNER: We have had a great deal of correspondence dealing with electric warming of beds, some asking questions, some telling us that it can be done, but the growers who are using this method appear to be very elusive. **IS** anyone in this country using an electric soil warming outfit for heating his mushroom beds on a commercial scale?

Extract from the Review of Applied Mycology.

Rust-and-Spot and Drop Diseases

Included in this useful, practical manual on mushroom (*Psalliota spp.*) cultivation* is a section on the diseases affecting the crop in Germany, namely, brown plaster mould (*Myriococcum praecox*), verdigris (*Myceliophthora lutea*) "weed" fungi, rust-and-spot disease, soft rot (*Mycogone perniciosa*), and drop disease.

There are two forms of rust-and-spot disease. The first is, generally speaking, harmless and consists in the development on the surface of the caps of rusty-brown spots arising from the bacterial contamination of water drops. The identity of the bacteria is unknown, but they are probably introduced into the cultures with the casing soil. The second form of the disease is more dangerous. It resembles the foregoing in the appearance of the superficial spots, but on cutting the mushrooms a green-blue discolouration of the flesh is revealed, and at a certain stage they become malodorous and inedible. Defective aeration and excessive humidity are believed to be responsible for the trouble.

Drop disease has been very prevalent of late years. The affected mushrooms become coated with a liquid, viscous mass and are of a watering consistency within. Growth is arrested. The disease is extraordinarily infectious, entire blocks being involved with the utmost rapidity, and together with soft rot it calls for extreme vigilance. Infected mushrooms should be promptly removed from the beds and destroyed. Like other maladies, e.g., brown plaster mould and verdigris, drop disease originates in the manure, though it may also be carried on the spawn. Drop disease is stated to be very common in Hungary.

*Hunte, (W.): Champignonanbau in Haupt und Nebenerwerb. Zweite neubearbeitete Auflage. (Mushroom cultivation as a main and ancillary industry. Second revised edition)—87 pp., 78 figs., 3 graphs, Berlin, Paul Parey, 1948.

THE FOLLOWING PUBLICATIONS ARE STILL IN PRINT AND ARE AVAILABLE FROM THE SECRETARY :

M.G.A. Bulletins 7, 12, 13, 14, 15 and 16.
Mushroom Pests and their Control.
Verticillium on Mushrooms.
White Plaster Mould.
New Insecticides : A Report.
Insecticides : Data for the Mushroom Grower.
Major Diseases of the Cultivated White Mushroom.
Mushroom Composting Processes.

Radio-Active Mushrooms?

An article in *Science* by four members of the University of Minnesota brings to light interesting facts concerning the production of *new strains* of the cream variety of the cultivated mushroom. The addition of a little uranium nitrate to the synthetic food material used in the laboratory has produced growth 5 to 7 times as vigorous as the parent stock; moreover, certain spawn produced mushrooms earlier than is usual, and the colour was white instead of brownish.

Before the spawn is sold for commercial use, the stability of these changes must be proved decisively, indicating that a mutation or change which is permanent has taken place. In other words, the spawn must go on exhibiting the characteristics for which it has been chosen. This selection of desirable characteristics is essentially laboratory work which involves long and careful study of the spawn under various conditions. The whole process originates in the pure culture of a single spore from the gills of a mushroom. Very little selection seems to have been practised up till now, but the use of uranium nitrate and other uranium salts in synthetic media may provide a simple and useful means for producing desirable mutations.

There may come a day when the grower will be offered a wide range of spawn from which to choose. At last he may be able to buy spawn which will withstand exigencies of temperature in the house which will never heat up, or the glasshouse which will never keep cool.

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C.D.

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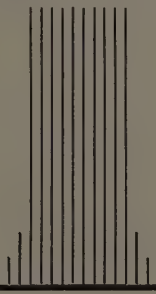

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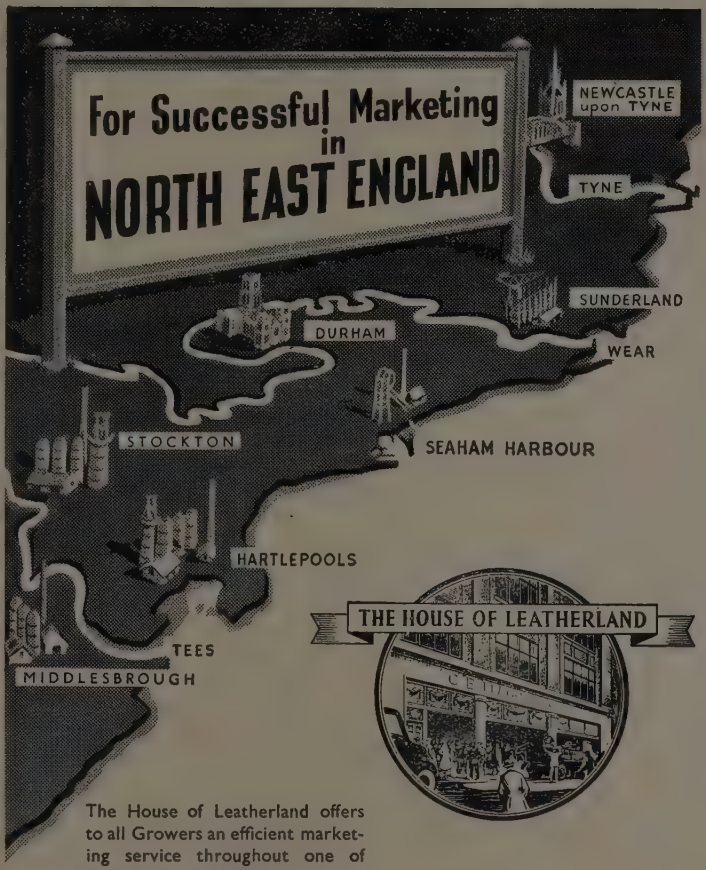

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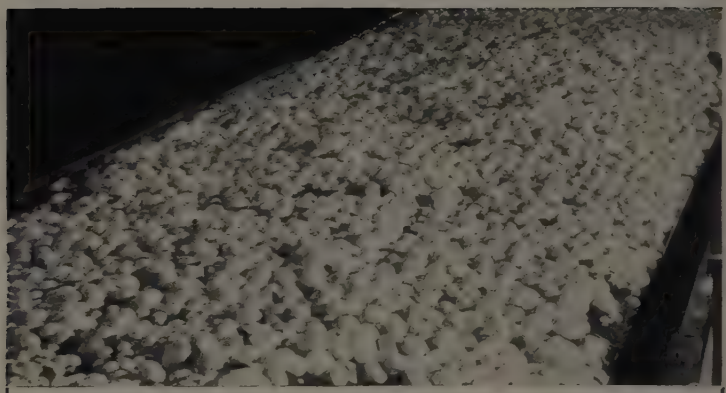

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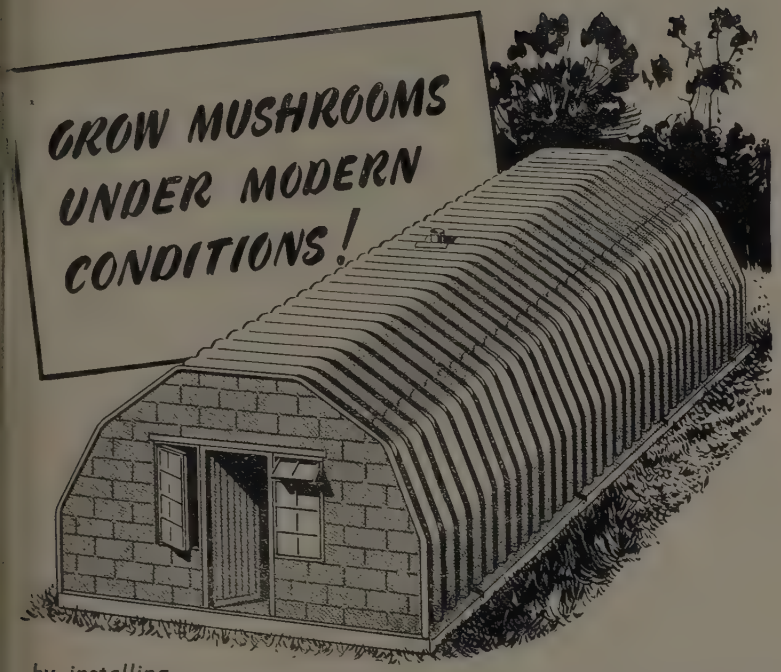

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John B. Yoder, Butler County Mushroom Farm, West Winfield, Pa., U.S.A.

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Dr. Edmund B. Lambert, Plant Industry Station, Beltsville, Maryland, U.S.A.
Dr. James W. Sinden, School of Agriculture, State College, Pa., U.S.A.
Dr. W. M. Ware, Brookfield, Wye, Nr. Ashford, Kent, England.

THE

FOURTH LUNCHEON AND ANNUAL GENERAL MEETING

of the

Mushroom Growers' Association

will be held at

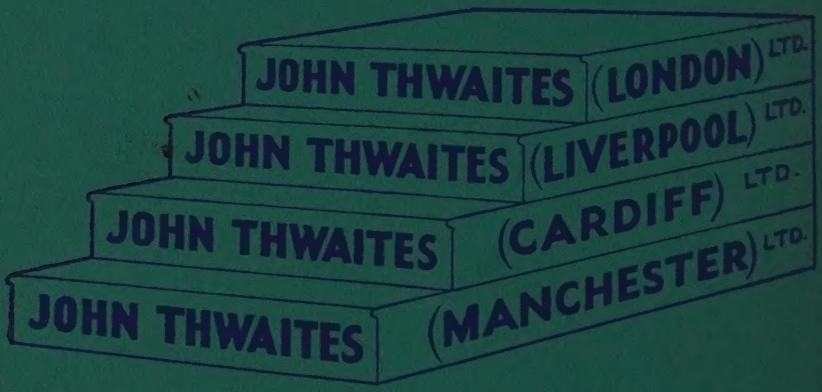
THE RESTAURANT FRASCATI
OXFORD STREET, LONDON
On Wednesday, 30th November, 1949

Dr. W. K. SLATER,
Secretary of the Agricultural Research Council of Great Britain, has graciously consented to be the
GUEST OF HONOUR

The Luncheon will commence at 12 noon, and the Meeting will follow at 2 p.m. prompt

Application for tickets (price 15/-) should be made to the Secretary before the 1st November, 1949

Take these



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